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CONSTRUCTION NOISE LEVELS

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COPLEY PLACE

CONSTRUCTION NOISE LEVELS

(REVISED)

HMM Document No. 80-082

July 1980

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1. INTRODUCTION

Since the noise study for Copley Place was done in December of 1979, the construction schedule for the site work has been significantly altered. The site preparation activities have been compacted by several months. This requires that more pieces of equipment operate during the early months of construction, resulting in potential for higher noise levels than those reported in the earlier studies. In addition, the new schedule calls for nighttime activity during the first four months of construction. This varies the time during which abuttors may be exposed to increased noise levels. This supplemental report has been compiled to describe the potential noise impacts associated with the changes in the Copley Place construction schedule.

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2. DATIME CONSTRUCTION NOISE LEVELS

2.1 Daytime Noise Models

In order to determine if the new construction schedule causes noise level peaks higher than those encountered in the original construction schedule, the first ten months of the new schedule were studied.

The equipment required at different locations around the construction site were re-defined according to the new schedule provided by the contractor. This schedule is included in Appendix A. Each month was evaluated in terms of the total number of pieces of construction equipment in use and the number of pieces of equipment located at each theoretical construction site center*. The number of particularly loud pieces of equipment, such as pile-drivers, in use at each construction site center was identified as well. The equipment usage each month was compared to the equipment in use during peak months in the earlier study.

Three of the ten months show levels of equipment usage near, or above, those predicted for peak months in the earlier study. Noise levels during these months, numbers 2, 5, and 6, were modeled to predict the construction noise levels at each of the six receptors (see Figure 2-1). The six receptors are those used in the previous studies. Each month was modeled with and without impact devices, since such equipment is not covered under current construction regulations for the City of Boston. The models and calculations for these three months are included as Appendix B.

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* The six theoretical site centerws were defined in the earlier Copley Place Noise Levels Report (December 1979). See Figure 2-1 for their locations.

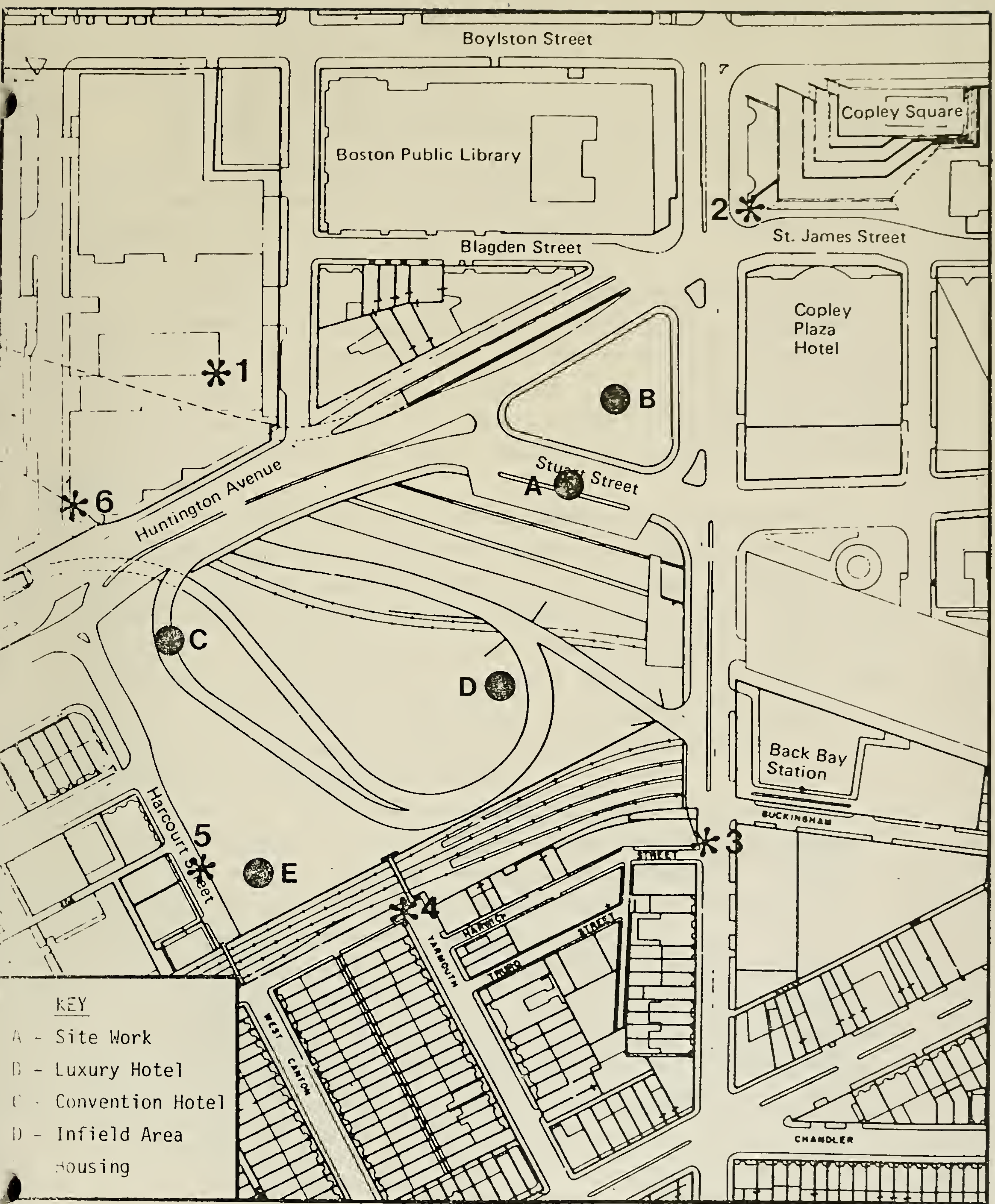

FIGURE 2-1 - THEORETICAL CONSTRUCTION ACTIVITY SITE CENTERS

2.2 Results of Daytime Models

The results of the construction noise models are shown on Table 2-1. The noise levels which have an asterisk are the only ones which exceed the peak noise level predicted for that receptor in the earlier study (see Table 2-2 and 2-3 for results of the earlier study).

At Receptor #1, the Gloucester Apartment Building, the peak predicted L_{eq} associated with construction (including impact devices) rises from the 77.9 dBA predicted for month 13 to 78.2 dBA predicted during month 6. This increase of 0.3 dBA is not significant. It is neither within the level of accuracy of the noise model, nor large enough to be perceptible to the human ear.

At Receptor #2, the corner of Copley Square, the peak predicted noise level (including impact devices) rises 3.1 dBA over the earlier predicted peak L_{eq} of 77.1 dBA. Without impact devices, the new predicted peak is 73.3 dBA. This is an increase of 2.6 dBA of the former predicted peak of 70.7. The human ear cannot generally perceive a difference in noise level of less than 3-5 dBA. Therefore, the significance of the increase in construction noise level over the earlier prediction is considered minimal.

At Receptor #3, the new predicted peak noise levels, including impact devices, are lower than the peak L_{eq} levels calculated for the original construction schedule. Without including impact devices, the new predicted peak level is 0.4 dBA higher than the former predicted peak L_{eq}. For reasons mentioned earlier, this difference is insignificant.

At the other three receptor locations, earlier modeled construction noise level peaks are higher than those predicted with the new schedule. Therefore, the revised construction schedule does not increase the peak noise impact at any of those locations.

TABLE 2-1

SUMMARY OF NOISE MODEL FOR REVISED CONSTRUCTION SCHEDULE

(L_{eq} dBA)

	Month	Receptor 1	2	3	4	5	6
With impact devices	2	77.0	77.7*	76.9	75.1	73.9	73.6
With impact devices	5	77.2	76.9	80.0	79.9	77.1	74.9
With impact devices	6	78.2*	80.2*	79.8	79.2	76.9	75.4
Without impact devices	2	71.3	72.0*	71.2	69.4	68.2	67.9
Without impact devices	5	70.1	70.2	72.3	72.0	69.3	67.5
Without impact devices	6	72.1	73.3*	74.9*	72.0	69.6	68.0

---

* Noise levels higher than peak level for receptor in earier modelling.

TABLE 2-2

ORIGINAL CONSTRUCTION NOISE MODEL SUMMARY

(with impact devices)

Model	Month	Receptor 1	2	3	4	5	6
1	3	74.1	75.2	73.9	72.1	70.9	70.7
2	4	74.5	77.1*	74.0	72.2	71.1	70.9
3	13	77.9*	72.8	75.2	77.6	80.9	81.4*
4	23	75.6	68.8	74.5	75.0	77.9	78.2
5	11	77.8	74.9	80.4*	80.7*	79.7	78.5
6	28	70.2	68.5	74.3	79.8	85.5*	72.2

---

* Peak noise at receptor.

TABLE 2-3

ORIGINAL CONSTRUCTION NOISE MODEL SUMMARY

(without impact devices)

Model	Month	Receptor 1	2	3	4	5	6
1	3	67.0	69.4	66.6	64.8	63.6	63.5
2	4	68.4	70.7*	68.0	67.5	65.1	64.9
3	13	71.1	70.5	72.9	73.5	73.3	72.9
4	23	75.6*	68.8	74.5*	75.0	77.9*	78.2*
5	11	69.2	67.2	70.6	70.9	70.8	70.4
6	28	69.5	68.2	74.4	75.6*	77.9*	71.5

---

* Peak noise at receptor.

In summary, the only receptor location which has a measurable increase in noise level based on this model is Receptor #2, Copley Square. The new predicted peak at this location without impact devices is 73.3 dBA. City regulations governing construction noise levels, shown on Table 2-4, specify a maximum L_{10} of 80 dBA for business/recreational locations such as Copley Square. This corresponds to an L_{eq} of approximately 78 to 79 dBA. The predicted peak L_{eq} of 73.3 dBA is well below the City standards.

TABLE 2-4

CITY OF BOSTON

SUMMARY OF RESTRICTION ON CONSTRUCTION SITE NOISE*

3.1 MAXIMUM LEVELS

Land Use of Affected Property	Maximum Noise Level Value Measure at Lot Line of Affected Property (dBA)	
	L_{10}	Maximum Noise Level
Residential Institutional	75	86
Business or Recreational	80	--
Industrial	85	--

(To be evaluated at distances not closer than 50 feet from nearest active construction device, using slow response of sound level meter.

3.2 MEASUREMENTS

- A-weighted
- At 10-second intervals, 100 sample total
- Measured L_{10} must exceed background L_{10} by 5 dBA for violation of 3.1.

3.4 Maximum levels under 3.1 do not apply to impact devices (pile drivers, paving breakers, riveters, etc.)

---

* City of Boston Air Pollution Control Commission, "Regulations for the Control of Noise in the City of Boston." Regulation 3, effective January 1, 1976.

3. NIGHTTIME CONSTRUCTION NOISE LEVELS

During the first four months of construction, two work tasks will take place during the night. In order to meet the new, shortened schedule, excavation of utility ditches along Dartmouth Street must take place during the night. This task will involve a backhoe, a truck and a compressor for lighting. This task will continue for the first two months of construction.

During months three and four, the structural steel beams will be placed over the Massachusetts Turnpike. For reasons of safety, traffic must be re-routed to the side of the Turnpike which is not below the beam operation. Provisions of the lease agreement between the Massachusetts Turnpike Authority and UIDC require that this occur at the off-peak hours from 12:00 midnight to 5:00 A.M. This work will involve trucks delivering the beams and a crane to lift them into place.

3.1 Nighttime Construction Noise Model #1: Utility Excavation

In order to predict the noise level associated with the nighttime excavation work, a construction equipment scenario was modeled for this activity. Appendix C includes the model and related calculations. Table 3-1 shows the predicted equivalent noise level at each receptor resulting from the utility excavation during the night. The peak noise level associated with construction is 66.2 dBA experienced at Receptor #2, Copley Square. This is expected, since it is adjacent to the site of the activity. This is the only receptor location at which the nighttime construction noise level is significantly higher than the ambient nighttime noise level of 61 dBA. Nighttime construction noise levels at the other five receptors range from a low of 57.7 dBA at Receptor #5 on Harcourt Street to 61.7 dBA at Receptor #1, the Gloucester Apartment Building.

TABLE 3-1

SUMMARY OF NIGHTTIME NOISE LEVELS

(L_{eq}, dBA)

Receptor	Model #1		Model #2	
	Construction Noise	Composite of Construction and Ambient Noise*	Construction Noise	Composite of Construction and Ambient Noise*
#1 Gloucester Apts.	61.7**	64.4	61.9**	64.5
#2 Copley Square	66.2	67.3	62.6	64.9
#3 Dartmouth St.	60.5**	63.8	61.8**	64.4
#4 Tent City	58.7**	63.0	60.0**	63.5
#5 Harcourt St.	57.7**	62.7	58.8**	63.0
#6 101 Huntington Ave.	57.9**	62.7	58.5**	62.9

Model #1: Utility Excavation

Model #2: Laying Beams over Turnpike

---

* 61.0 dBA (ambient noise level), added to predicted construction noise emission level.

** Construction noise levels near, or below, the ambient nighttime noise level of 61.0 dBA.

When these peak noise levels associated with construction are added to the background nighttime noise level of 61 dBA measured at Harcourt Street (Receptor #5), the peak nighttime noise level at Receptor #2 is 67.3 dBA. This is an increase in the nighttime noise level at Copley Square of 6.3 dBA over the ambient nighttime noise level. This increase is significant enough to be perceived by the human ear, and may be noticeable to some guests of the Copley Plaza Hotel. At the remaining five receptor locations, the construction noise level is near, or below, the ambient nighttime noise level of 61 dBA. However, the construction noise will contribute to noise levels. Nighttime equivalent noise levels experienced at the other five receptors range from 64.4 dBA at the Gloucester Apartment building to 62.7 dBA at both Receptor #5, Harcourt Street, and Receptor #6, the 101 Huntington Avenue Office Building. These represent small noise increases over the ambient noise level of 61 dBA which would not be generally noticeable.*

3.2 Nighttime Construction Noise Model #2: Laying Beams Over Turnpike

The night activity over the turnpike during months three and four was modeled to predict the level of noise emitted. The model and related calculations are included in Appendix C. Table 3-1 lists the predicted construction noise levels associated with the turnpike superstructure work.

The receptor which experiences the most noise from this activity is, again, Receptor #2, Copley Square. At this receptor, the 12:00 midnight to 5:00 A.M. activity will produce a 62.6 dBA noise level. Receptors #1, the Gloucester Apartment

---

* It should be noted that these modeled results examine the equivalent noise level which tends to smooth out peaks, therefore disguising the irregular nature of the activity which could be more annoying than numerical analysis would indicate.

Building, and #3, Dartmouth Street, experience slightly lower L_{eq}s from this construction; 61.9 dBA and 61.8 dBA, respectively. These noise levels are not significantly higher than the ambient 61.0 dBA. The noise levels at the remaining three receptors are below the ambient nighttime noise levels, ranging from 60.0 dBA at Receptor #4, Tent City, to 58.5 dBA at Receptor #6, the 101 Huntington Avenue Office Building. Thus, the range of construction-related noise levels experienced at all six receptor locations is 4.1 dBA; from a peak of 62.6 dBA to a low of 58.5 dBA.

The actual noise levels predicted at each receptor, resulting from construction noise levels added to the 61 dBA background L_{eq}, are also presented on Table 3-1. For the construction over the turnpike, the noise levels experienced at the six receptors range from 64.9 dBA at Copley Square to 62.9 dBA at the 101 Huntington Avenue Office Building. This range of 2.0 dBA represents an increase of 1.9 dBA to 3.9 dBA over the ambient L_{eq} of 61.0 dBA. These increases are at the bottom of the 3-5 dBA range generally accepted as being the threshold of human perception.

3.3 Mitigating Measures

There are several specific measures which will be taken to mitigate the impacts associated with the night construction work. Copley Place is currently scheduled to begin construction in October, 1980. This means that the night construction will take place during the months of October, November, December, and January. These are not months when local residents or guests of the Copley Plaza Hotel would have windows open at night, thus reducing the potential impact of noise at night. In addition, the utility excavation is specifically planned so that a single truck will move the excavated material from the site of the digging on Dartmouth Street to the triangular site. These two measures will help mitigate the negative impacts associated with the nighttime construction activity.

4. GENERAL CONCLUSIONS

4.1 Impacts of Revised Daytime Construction Schedule

The only modeled location at which the revised construction schedule will cause a measurable increase in peak construction noise level is Receptor #2, Copley Square. At this location, the peak L_{eq} associated with construction (including impact devices) rises 3.1 dBA over the earlier predicted peak at this location. This increase is at the edge of the threshold of normal human perception. The resulting peak L_{eq} at this location, without impact devices, is 73.3 dBA. This is well below the peak construction noise level of approximately 78 to 79 dBA level cited by the City of Boston, in its noise regulations governing business/recreational locations.

4.2 Impacts of Nighttime Construction Noise Levels

Model #1: Utility Excavation

The peak L_{eq} resulting from the utility excavation is 66.2 dBA, experienced at Receptor #2, Copley Square. The noise experienced at other receptors is near, or below, the ambient nighttime L_{eq} of 61.0 dBA. When the construction noise is superimposed on existing background noise, the noise level rises about 2 to 3 dBA, except for Receptor #2, where the noise level increases 6.3 dBA. Therefore, receptor #2 is the only location modeled where a perceived difference in noise levels will occur.

Model #2: Laying Beams Over Turnpike

The largest noise level associated with this activity will be 62.2 dBA encountered at Receptor #2. When superimposed on

the 61.0 DBA background noise level, this results in 64.9 dBA, or an increase of 3.9 dBA. Thus, the largest increase in L_{eq} resulting from the work over the Turnpike is at the bottom of the 3-5 dBA threshold range at which a noise level increase is perceived by humans.

APPENDICES

APPENDIX A - REVISED CONSTRUCTION EQUIPMENT LOCATION SCHEDULE
APPENDIX B - DAYTIME MODELS AND CALCULATIONS
APPENDIX C - NIGHTTIME MODELS AND CALCULATIONS

APPENDIX A - REVISED CONSTRUCTION EQUIPMENT LOCATION SCHEDULE

REVISED CONSTRUCTION EQUIPMENT LOCATION SCHEDULE

7/7/80

* 12 MIDNIGHT TO 5 AM ONLY
** 24 HOURS PER DAY

Month #Pieces (Location)

Equipment	1	2	3	4	5	6	7	8	9	10
Pile Driver/auger	3(A)	3(A)		2(B)	2(B) 3(D)	2(A) 2(B) 2(D)	2(A) 2(B) 2(D)	2(D)	1(C) 2(D)	1(C) 2(D)
Compressor	1(A)**	1(A)**								
Jackhammer/Compressor	3(A)	3(A)	3(A)		2(B) 1(D)	2(A) 2(B) 1(D)	2(A) 2(B) 1(D)	1(D)	C(1) 1(D)	1(C) 1(D)
Pump										
Backhoe	2(A)	2(A)	2(A)	1(B)	1(B) 2(D)	1(B) 1(D)	2(A)	2(A)		
Loader	2(A) 1(A)**	2(A) 1(A)**	1(A)		1(B) 2(D)	1(B) 2(D)	1(D)			
Bulldozer										
Crane	3(A)	3(A)	3(A)	1(A)*	2(B) 1(D)	2(A) 2(B)	2(A) 2(B)			
Paving Ripper	3(A)	3(A)			1(D)			2(A)		
Cherry Picker	1(A)	3(A)	3(A)	2(A)			2(A)	2(A)	2(A)	
Truck	4(A) 1(A)**	4(A) 1(A)**	4(A) 5(A)*	5(A)* 4(B)	6(B) 12(D)	6(B) 13(D)	4(A) 12(D)	4(A)		
Paver										
Rolling Compactor										
Concrete Truck		4(A)	4(A)	4(A)	1(B)	1(B)		2(A)	2(A)	
Hoist										
Forklift										
Mortar Mixer										
Concrete Dump		1(A)	1(A)	1(A)	1(B)	1(B)		1(A)	1(A)	
Demo-Crane										
TOTAL PIECES	21	28	21	17	38	41	36	16	10	5
Pieces at Ⓐ	21	28	21	10	—	6	14	13	5	—
Pieces at Ⓑ	—	—	—	7	16	16	6	—	—	—
Pieces at Ⓒ	—	—	—	—	—	—	—	—	2	[illegible]
Pieces at Ⓓ	—	—	—	—	22	19	16	3	3	[illegible]
Pieces at										

APPENDIX B - DAYTIME MODELS AND CALCULATIONS

SUMMARY OF CONSTRUCTION NOISE MODEL FOR REVISED SCHEDULE
(Leq dBA)

		RECEPTOR					
	MONTH	1	2	3	4	5	6
with impact devices	2	77.0	77.7*	76.9	75.1	73.9	73.6
with impact devices	5	77.2	76.9	80.0	79.9	77.1	74.9
with impact devices	6	78.2*	80.2*	79.8	79.2	76.9	75.4
with-out impact devices	2	71.3	72.0*	71.2	69.4	68.2	67.9
with-out impact devices	5	70.1	70.2	72.3	72.0	69.3	67.5
without impact devices	6	72.1	73.3*	74.9*	72.0	69.6	68.0
~~with or without~~	~~3~~	~~71.2~~	~~71.9~~	~~71.1~~	~~69.3~~	~~68.1~~	~~67.8~~

* Noise levels higher than peak level for receptor in earlier modelling.

$\boxed{\text{Month 2}}$ with impact devices

Leq @ Receptor $\boxed{1}$

Ⓐ $97.9 - 20 \log {}^{550}/_{50} = 97.9 - 20.9 = 77.0$ dBA

Leq @ Receptor $\boxed{2}$

Ⓐ $97.9 - 20 \log {}^{510}/_{50} = 97.9 - 20.2 = 77.7$ dBA

Leq @ Receptor $\boxed{3}$

Ⓐ $97.9 - 20 \log {}^{560}/_{50} = 97.9 - 21.0 = 76.9$ dBA

Leq @ Receptor $\boxed{4}$

Ⓐ $97.9 - 20 \log {}^{688}/_{50} = 97.9 - 22.8 = 75.1$ dBA

Leq @ Receptor $\boxed{5}$

Ⓐ $97.9 - 20 \log {}^{795}/_{50} = 97.9 - 24.0 = 73.9$ dBA

Leq @ Receptor $\boxed{6}$

Ⓐ $97.9 - 20 \log {}^{820}/_{50} = 97.9 - 24.3 = 73.6$ dBA

MONTH 2 revised construction model

1) no barriers

2) @ Site Center Ⓐ

	w/ impact	w/o impact
3 pile drivers @	91 dBA (3)	OMIT
3 compressors @	81 dBA (3)	same
2 backhoes @	77 dBA (2)	
2 loaders @	75 dBA (2)	
3 cranes @	75 dBA (3)	
3 paving rippers @	84 dBA (3)	OMIT
3 cherry pickers @	78 dBA (3)	same
4 trucks @	75 dBA (~~3~~4)	
4 concrete trucks @	82 dBA (4)	
1 concrete pump @	78 dBA	
SUBTOTAL	97.9	92.2

$\boxed{\text{Month 2}}$ without impact devices

Leq @ Receptor $\boxed{1}$

Ⓐ $92.2 - 20 \log {}^{550}/_{50} = 92.2 - 20.9 = 71.3$ dBA

Leq @ Receptor $\boxed{2}$

Ⓐ $92.2 - 20 \log {}^{510}/_{50} = 92.2 - 20.2 = 72.0$ dBA

Leq @ Receptor $\boxed{3}$

Ⓐ $92.2 - 20 \log {}^{560}/_{50} = 92.2 - 21.0 = 71.2$ dBA

Leq @ Receptor $\boxed{4}$

Ⓐ $92.2 - 20 \log {}^{688}/_{50} = 92.2 - 22.8 = 69.4$ dBA

Leq @ Receptor $\boxed{5}$

Ⓐ $92.2 - 20 \log {}^{795}/_{50} = 92.2 - 24.0 = 68.2$ dBA

Leq @ Receptor $\boxed{6}$

Ⓐ $92.2 - 20 \log {}^{820}/_{50} = 92.2 - 24.3 = 67.9$ dBA

MONTH 5 construction noise - revised schedu
(Leq)

1) No Barriers

2) At Site Center (B)

		with impact	w/o impact
2 pile drivers	@	91 dBA(2)	OMIT
2 compressors		81 dBA(2)	same
1 Backhoe		77 dBA	
1 Loader		75 dBA	
2 Cranes		75 dBA(2)	
6 trucks		75 dBA(6)	
1 concrete truck		82 dBA	
1 concrete pump		78 dBA	
SUBTOTAL		95.2	89.1

3) At Site Center (D)

3 pile drivers	@	91 dBA(3)	OMIT
1 compressor	@	81 dBA	same
2 backhoes	@	77 dBA(2)	
2 loaders	@	75 dBA(2)	
1 crane	@	75 dBA	
1 paving ripper	@	84 dBA	OMIT
12 trucks	@	75 dBA (12)	same
SUBTOTAL		96.7	88.5

with impact devices

MONTH 5 revised construction noise

Leq at Receptor 1

Ⓐ ——
Ⓑ $95.2 - 20 \log 595/50 = 95.2 - 21.5 =$ 73.7
Ⓒ ——
Ⓓ $96.7 - 20 \log 630/50 = 96.7 - 22.0 =$ 74.7
Ⓔ ——

77.2 dBA

Leq at Receptor 2

Ⓑ $95.2 - 20 \log 355/50 = 95.2 - 20.2 =$ 75.0
Ⓓ $96.7 - 20 \log 820/50 = 96.7 - 24.3 =$ 72.4

76.9 dBA

Leq @ Receptor 3

Ⓑ $95.2 - 20 \log 680/50 = 95.2 - 22.7 =$ 72.5
Ⓓ $96.7 - 20 \log 875/50 = 96.7 - 17.5 =$ 79.2

80.0 dBA

Leq @ Receptor 4

Ⓑ $95.2 - 20 \log 840/50 = 95.2 - 24.5 =$ 70.7
Ⓓ $96.7 - 20 \log 370/50 = 96.7 - 17.4 =$ 79.3

79.9 dBA

Month 5

with impact devices

Leq @ Receptor 5

Ⓑ $95.2 - 20 \log 945/50 = 95.2 - 25.5 = 69.7$
Ⓓ $96.7 - 20 \log 530/50 = 96.7 - 20.5 = 76.2$

77.1 dBA

Leq at Receptor 6

Ⓑ $95.2 - 20 \log 920/50 = 95.2 - 25.3 = 69.9$
Ⓓ $96.7 - 20 \log 750/50 = 96.7 - 23.5 = 73.2$

74.9 dBA

$\boxed{\text{Month 5}}$ without impact devices

Leq @ Receptor $\boxed{1}$

Ⓑ $89.1 - 20 \log 595/50 = 89.1 - 21.5 =$ 67.6
Ⓓ $88.5 - 20 \log 630/50 = 88.5 - 22.0 =$ 66.5
70.1 dBA

Leq @ Receptor $\boxed{2}$

Ⓑ $89.1 - 20 \log 355/50 = 89.1 - 20.2 =$ 68.9
Ⓓ $88.5 - 20 \log 820/50 = 88.5 - 24.3 =$ 64.2
70.2 dBA

Leq @ Receptor $\boxed{3}$

Ⓑ $89.1 - 20 \log 680/50 = 89.1 - 22.7 =$ 66.4
Ⓓ $88.5 - 20 \log 375/50 = 88.5 - 17.5 =$ 71.0
72.3 dBA

Leq @ Receptor $\boxed{4}$

Ⓑ $89.1 - 20 \log 840/50 = 89.1 - 24.5 =$ 64.6
Ⓓ $88.5 - 20 \log 370/50 = 88.5 - 17.4 =$ 71.1
72.0 dBA

month 5, w/o impact devices

Leq @ Receptor $\boxed{5}$

Ⓑ $89.1 - 20\log {}^{945}/_{50} = 89.1 - 25.5 = 63.6$

Ⓓ $88.5 - 20\log {}^{530}/_{50} = 88.5 - 20.5 = \underline{68.0}$

69.3 dBA

Leq @ Receptor $\boxed{6}$

Ⓑ $89.1 - 20\log {}^{920}/_{50} = 89$[illegible] $- 25.3 = 63.8$

Ⓓ $88.5 - 20\log {}^{750}/_{50} = 88.5 - 23.5 = \underline{65.0}$

67.5 dBA

41 pieces of equipment

CONSTRUCTION NOISE – REVISED MONTH 6

1. No barriers

2. @ Site Center Ⓐ

		Leq w/Impact	w/o impact
2 pile drivers	@	91 dBA(2)	OMIT
2 compressors	@	81 dBA(2)	~~OMIT~~ same
2 cranes	@	75 dBA(2)	SAME
SUBTOTAL		94.5 dBA	85.0

3. @ Site Center Ⓑ

		Leq w/Impact	w/o impact
2 pile drivers	@	91 DBA(2)	OMIT
2 compressors	@	81 dBA(2)	~~OMIT~~ same
1 backhoe	@	77 dBA	same
1 loader	@	75 dBA	same
2 cranes	@	75 dBA(2)	same
6 trucks	@	75 dBA(6)	same
1 concrete truck	@	82 dBA	same
1 concrete pump	@	78 dBA	same
SUBTOTAL		95.2 dBA	89.1 dBA

3. Site Center Ⓓ

	w/impact	w/o impact
2 pile drivers @	91 dBA(2)	OMIT
1 compressor @	81 dBA	same
2 loaders @	75 dBA(2)	
1 backhoe @	77 dBA	
13 trucks @	75 dBA(13)	
SUBTOTAL	95.0 dBA	87.9 dBA

w/impact devices

Construction Noise - Month 6 - revised

Leq @ Receptor $\boxed{1}$ (with impact devices)

Ⓐ $94.5 - 20 \log {}^{550}/_{50} = 94.5 - 20.9 = 73.6$
Ⓑ $95.2 - 20 \log {}^{595}/_{50} = 95.2 - 21.5 = 73.7$
Ⓒ ——
Ⓓ $95.0 - 20 \log {}^{630}/_{50} = 95 - 22.0 = 73.0$
Ⓔ ——

78.2 dBA

Leq @ Receptor $\boxed{2}$

Ⓐ $94.5 - 20 \log {}^{510}/_{50} = 94.5 - 20.2 = 74.3$
Ⓑ $95.2 - 20 \log {}^{355}/_{50} = 95.2 - 17.0 = 78.2$
Ⓒ ——
Ⓓ $95.0 - 20 \log {}^{820}/_{50} = 95.0 - 24.3 = 70.7$
Ⓔ

80.2 dBA

Leq @ Receptor $\boxed{3}$

Ⓐ $94.5 - 20 \log {}^{560}/_{50} = 94.5 - 21.0 = 73.5$
Ⓑ $95.2 - 20 \log {}^{680}/_{50} = 95.2 - 22.7 = 72.5$
Ⓒ ——
Ⓓ $95.0 - 20 \log {}^{875}/_{50} = 95.0 - 17.5$ 77.5
Ⓔ ——

79.8 dBA

month 6
w/impact

Leq @ Receptor $\boxed{4}$

Ⓐ $94.5 - 20\log {}^{688}/_{50} = 94.5 - 22.8 = 71.7$
Ⓑ $95.2 - 20\log {}^{840}/_{50} = 95.2 - 24.5 = 70.7$
Ⓒ ———
Ⓓ $95.0 - 20\log {}^{370}/_{50} = 95.0 - 17.4 = 77.6$
Ⓔ ———

79.2 dBA

Leq @ Receptor $\boxed{5}$

Ⓐ $94.5 - 20\log {}^{795}/_{50} = 94.5 - 24.0 = 70.5$
Ⓑ $95.2 - 20\log {}^{945}/_{50} = 95.2 - 25.5 = 69.7$
Ⓒ ———
Ⓓ $95.0 - 20\log {}^{530}/_{50} = 95.0 - 20.5 = 74.5$
Ⓔ ———

76.9 dBA

Leq @ Receptor $\boxed{6}$

Ⓐ $94.5 - 20\log {}^{820}/_{50} = 94.5 - 24.3 = 70.2$
Ⓑ $95.2 - 20\log {}^{920}/_{50} = 95.2 - 25.3 = 69.9$
Ⓒ ———
Ⓓ $95.0 - 20\log {}^{750}/_{50} = 95.0 - 23.5 = 71.5$
Ⓔ ———

75.4 dBA

w/o impact devices

$\boxed{\text{MONTH 6}}$ - Revised Construction Noise

Leq @ Receptor $\boxed{1}$

Ⓐ $85.0 - 20 \log {}^{550}/_{50} = 85.0 - 20.9 =$ 64.1
Ⓑ $89.1 - 20 \log {}^{595}/_{50} = 89.1 - 21.5 =$ 67.6
Ⓒ ——
Ⓓ $87.9 - 20 \log {}^{630}/_{50} = 87.9 - 22.0 =$ 65.9
Ⓔ ——

72.1 dBA

Leq @ Receptor $\boxed{2}$

Ⓐ $85.0 - 20 \log {}^{510}/_{50} = 85.0 - 20.2 =$ 64.8
Ⓑ $89.1 - 20 \log {}^{355}/_{50} = 89.1 - 17.0 =$ 72.1
Ⓒ ——
Ⓓ $87.9 - 20 \log {}^{820}/_{50} = 87.9 - 24.3 =$ 63.6
Ⓔ ——

73.3 dBA

Leq @ Receptor $\boxed{3}$

Ⓐ $85.0 - 20 \log {}^{560}/_{50} = 85.0 - 21.0 =$ 64.0
Ⓑ $89.1 - 20 \log {}^{680}/_{50} = 95.2 - 22.7 =$ 72.5
Ⓒ ——
Ⓓ $87.9 - 20 \log {}^{875}/_{50} = 87.9 - 17.5 =$ 70.4
Ⓔ ——

74.9 dBA

Month 6
w/o impact devices

Leq @ Receptor $\boxed{4}$

Ⓐ $85.0 - 20 \log {}^{688}/_{50} = 85.0 - 22.8 = 62.2$
Ⓑ $89.1 - 20 \log {}^{840}/_{50} = 89.1 - 24.5 = 64.6$
Ⓒ ———
Ⓓ $87.9 - 20 \log {}^{370}/_{50} = 87.9 - 17.4 = 70.5$
Ⓔ ———

72.0 dBA

Leq @ Receptor $\boxed{5}$

Ⓐ $85.0 - 20 \log {}^{795}/_{50} = 85.0 - 24.0 = 61.0$
Ⓑ $89.1 - 20 \log {}^{945}/_{50} = 89.1 - 25.5 = 63.6$
Ⓒ ———
Ⓓ $87.9 - 20 \log {}^{530}/_{50} = 87.9 - 20.5 = 67.4$
Ⓔ ———

69.6 dBA

Leq @ Receptor $\boxed{6}$

Ⓐ $85.0 - 20 \log {}^{820}/_{50} = 85.0 - 24.3 = 60.7$
Ⓑ $89.1 - 20 \log {}^{920}/_{50} = 89.1 - 25.3 = 63.8$
Ⓒ ———
Ⓓ $87.9 - 20 \log {}^{750}/_{50} = 87.9 - 23.5 = 64.4$
Ⓔ ———

68.0 dBA

APPENDIX C - NIGHTTIME MODELS AND CALCULATIONS

SUMMARY OF NIGHTTIME MODELS (Leq, dBA)

	MODEL	
RECEPTOR	1	2
1	61.7	61.9
2	66.2	62.6
3	60.5	61.8
4	58.7	60.0
5	57.7	58.8
6	57.9	58.5

model 1: Utility work on Dartmouth Street; months 1 & 2

model 2: Work over turnpike; months 3 & 4

Night-time Noise Model #1

Utility work on Dartmouth Street
Months 1 * 2

Approximate Leq at Site Center Ⓑ

1 Backhoe	77 dBA
1 Truck	75 dBA
1 Compressor	81 dBA
	83.2 dBA

Leq at Receptors:

$\boxed{1}$ $83.2 - 20 \log {}^{595}/_{50} = 83.2 - 21.5 = 61.7$ dBA

$\boxed{2}$ $83.2 - 20 \log {}^{355}/_{50} = 83.2 - 17.0 = 66.2$ dBA

$\boxed{3}$ $83.2 - 20 \log {}^{680}/_{50} = 83.2 - 22.7 = 60.5$ dBA

$\boxed{4}$ $83.2 - 20 \log {}^{840}/_{50} = 83.2 - 24.5 = 58.7$ dBA

$\boxed{5}$ $83.2 - 20 \log {}^{945}/_{50} = 83.2 - 25.5 = 57.7$ dBA

$\boxed{6}$ $83.2 - 20 \log {}^{920}/_{50} = 83.2 - 25.3 = 57.9$ dBA

Night-time Noise Model #2

Beam work over Mass. Turnpike
12 midnight to 5 AM during months 3 & 4

Approximate Leq at Site Center Ⓐ

1 crane	75 dBA
5 trucks	75 dBA(5)
	82.8 dBA

Leq at Receptors

$\boxed{1}$ $82.8 - 20 \log {}^{550}/_{50} = 82.8 - 20.9 = 61.9$ dBA

$\boxed{2}$ $82.8 - 20 \log {}^{510}/_{50} = 82.8 - 20.2 = 62.6$ dBA

$\boxed{3}$ $82.8 - 20 \log {}^{560}/_{50} = 82.8 - 21.0 = 61.8$ dBA

$\boxed{4}$ $82.8 - 20 \log {}^{688}/_{50} = 82.8 - 22.8 = 60.0$ dBA

$\boxed{5}$ $82.8 - 20 \log {}^{795}/_{50} = 82.8 - 24.0 = 58.8$ dBA

$\boxed{6}$ $82.8 - 20 \log {}^{820}/_{50} = 82.8 - 24.3 = 58.5$ dBA

COPLEY PLACE
H 112 A
CN

AUTHOR Urban Investment & Dev

TITLE Copley Place Construction

DATE LOANED	BORROWER'S NAME

ACCOPRESS

25070	YELLOW
25071	BLACK
25072	LIGHT BLUE
25073	DARK BLUE
25074	LIGHT GRAY
25075	LIGHT GREEN
25076	DARK GREEN
25077	[illegible]
25078	[illegible]
25079	EXECUTIVE RED

WITH WATER RESISTANT
PRESSTEX
COVERS

ACCO INTERNATIONAL INC.
CHICAGO, ILLINOIS 60619